MULTIMEDIA **UNIVERSITY**

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FINAL EXAMINATION

TRIMESTER 2, 2018/2019

DCS5068 – DATA STRUCTURE AND ALGORITHMS
(For DIT students only)

06 MARCH 2019
02.30 p.m – 04.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This examination paper consists of **SIX (6)** pages excluding cover page.

2. There are **FOUR (4)** structured questions.

3. Please write all your answers in the Answer Booklet provided.

Instruction: Write your answers in the answer booklet provided. Total marks is 50.

QUESTION 1 [10 Marks]

a) Declare a structure named **Students** with 8 members:
   - *name* as string
   - *id* as string
   - *group* as string
   - *programme* as string
   - *courseworkMark* as float
   - *finalMark* as float
   - *total* as float
   - *grade as* character

   Create two instances of the **Students** structure named *local* and *non_local*.

   (3 marks)

b) Write the output from the code given in Figure 1 when compiled and executed.

   (7 marks)

```
void f(int,int&);
void k(int&,int);

int w = 0;

int main ()
{
   int m=22;
   int n=4;

   cout<<"M = "<<m<<"\n";
   cout<<"N = "<<n<<"\n";

   f(m,n);

   cout<<"W = "<<w<<"\n";
   cout<<"N = "<<n<<"\n";
   return 0;
}
```

Continued ...

```
void f(int x, int& y)
{
  int m = 0;
  x += 29;
  y *= 55;
  if (x>50)
  {
    m = x;
    x = y;
    y = m;
  }
  k(y,x);
  w = x;
}

void k(int& x, int y)
{
  int t[] = {2,4,6,8,10};
  int total = 0;
  cout<<"{ ";
  for (int i = 0; i<5;i++)
  {
    x += t[i];
    t[i] = x;
    total = total + x;
    cout<<t[i]<<" , ";
  }
  cout<<" }"<<"\n";
  y += total;
  cout<<"Total= "<<total<<"\n";
}
```

Figure 1

Continued ...

QUESTION 2 [10 Marks]

a) What are some of the advantages linked lists have over arrays?

(2 marks)

b) Consider the following code in Figure 2:

```
struct ListNode {
   int value;
   struct ListNode *next;
};
ListNode *head; // List head pointer
```

Figure 2

Assume that a linked list object ListNode has been created and head points to the first node. Write code that traverses the list displaying the contents of each node's value.

(4 marks)

c) A stack may be implemented using a linked list and expand or shrink with each push or pop operation. Complete the push function for the MyStack class in Figure 3.

(4 marks)

```
class MyStack
{
    private: // Structure for stack nodes
        struct StackNode {
          int value; // Value in the node
          StackNode *next; // Pointer to the next node
        };
        StackNode *top; // Pointer to the stack top

    public:
        // Constructor
        MyStack() { top = nullptr; }
        // Destructor
        ~MyStack();

        // Stack operations
        void push(int);  // add a node
        void pop(int &); // delete a node
        bool isEmpty();
};
```

Continued ...

```
void MyStack::push(int num)   {
        // Allocate a new node and store num there.
        StackNode *newNode = new StackNode;
        newNode->value = num;
        newNode->next = nullptr;

        // Complete the code here
}
```

Figure 3

QUESTION 3 [15 Marks]

a) By using binary search, show the step by step diagram, calculation and labels, how to find 'R' from the following characters in the array in Figure 4.

(5 marks)

	B	D	G	J	M	P	T	V	Z
Index:	0	1	2	3	4	5	6	7	8

Figure 4

b) Assume a hash table with 9 locations and the hashing function $h(x) = x \% 9$. Calculate the index for each key and the result of the hash table when the following integers are inserted in the order given. Use *quadratic probing* if clashing occurs.

(10 marks)

2106, 637, 125, 86, 520, 183, 393, 418

Continued ...

QUESTION 4 [15 Marks]

a) Define binary tree in data structure and algorithms.

(2 marks)

b) Answer all of the following questions based on tree given in Figure 5. Each question is independent of each other.
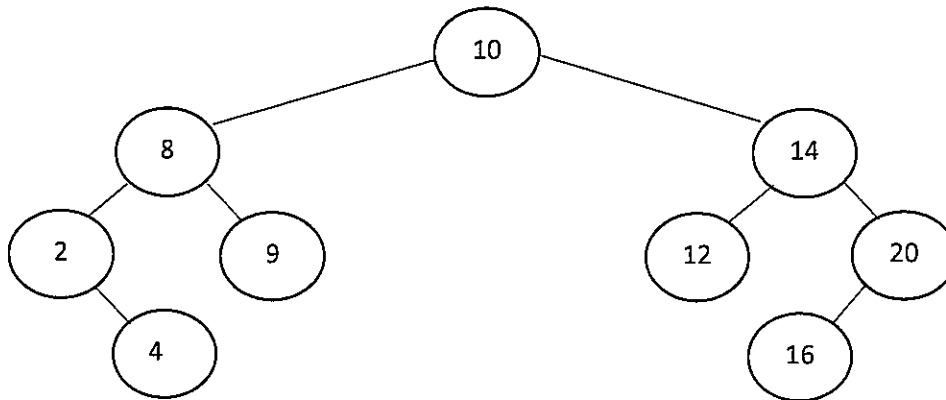

Figure 5

i) List all leaf nodes.

(1 mark)

ii) Write the *PreOrder* traversal.

(2 marks)

iii) Draw the binary tree after adding node with value 17 and deleting node with value 2.

(2 marks)

iv) If the root node is deleted, which will be the new root node value?

(1 mark)

Continued ...

c) Consider the following specification of a graph **G**:

      Vertices(G) = {1, 2, 3, 4}
      Edges(G) = {(1, 2), (2, 4), (2,3), (4, 3)}

i) Draw a directed graph.

                            (4 marks)

ii) Write its adjacency matrix.

                            (2 marks)

iii) Does path 2,4,3,2 constitute a cycle? Give reason(s) to support your answer.

                            (1 mark)

End of Page.